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(54) H.P. reciprocating pumps

(57) The H.P. reciprocating pump has a composite piston rod comprising a power end component (10), a fluid end component (11) and a connector (12) releasably connected to said end components. The connector (12) has a pair of tensioned links (15) extending therefrom and apertures (20) in the components and respective links co-operate for location of a locking pin therein. Pressure means (16–19) within the connector causes movement of the links against tension to permit coupling or uncoupling and for returning the links under tension to secure the components when coupled against release. The coupling means comprises a valve (22) provided in the body (13) of the connector (12) to inject or release pressure fluid into or out of a space (17) between two pistons (18) which form the links.

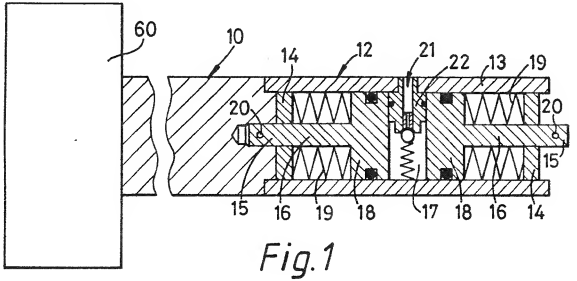

Fig.1

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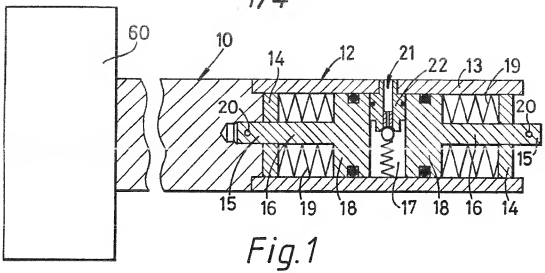

Fig.1

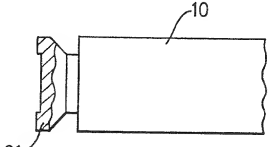

Fig. 2

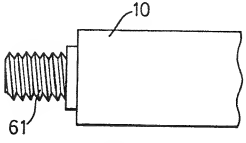

Fig. 3

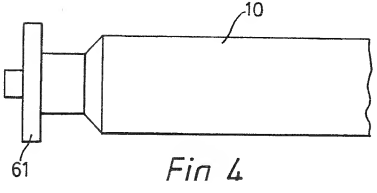

Fig. 4

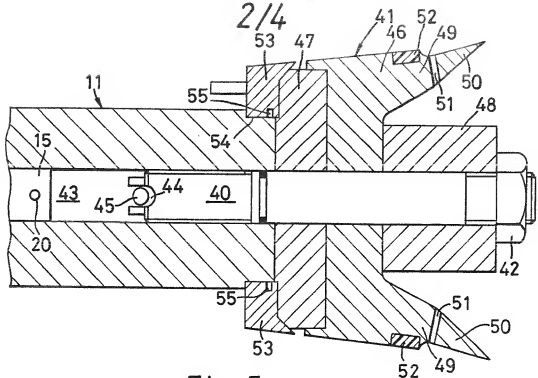

Fig. 5

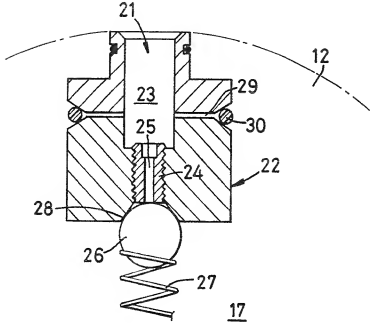

Fig. 6

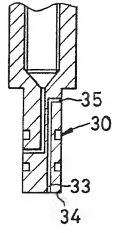

Fig. 7

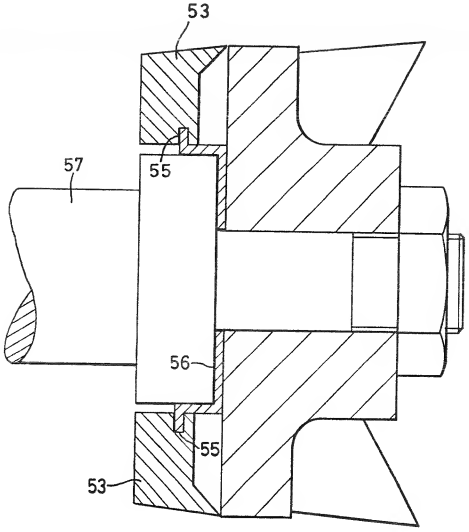

Fig. 8

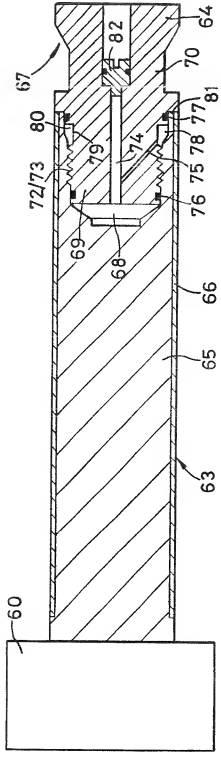
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Fig. 9

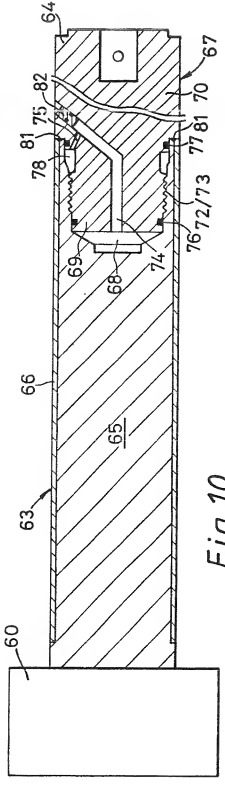
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Fig. 10

SPECIFICATION

H.P. reciprocating pumps

This invention relates to H.P. Reciprocating pumps.

Such pumps commonly known as slush pumps are used in the oil production industry for pumping drilling mud and other fluids at high pressure. They are designed to handle slurries of an abrasive nature and as a result piston replacement has a frequency that is generally three times as great any other associated component.

These pumps can be functionally divided into two sections, the fluid end and the power end.

The piston rod is the component in the pump that links the primary dynamic component, of the pump's fluid end, the piston, to the dynamic components of the pump's power end and is an assembly comprising the power end component, the fluid end component and a connector which is coupled to both end components. When replacement is necessary the connector has to be uncoupled and this at present can be time consuming due to known coupling arrangements. In addition, there are several different types of power end components from different manufacturers but no universal connector by which each can be connected to the piston which is generally a standard fluid end component having standized A.P.I. (American Petroleum Institute) connectors, e.g. the SA—4 type.

An object of this invention is to provide a connector which can quickly connect and disconnect for quick make-up or quick release of the piston rod assembly, and to be universal.

Another problem that exists with mud pumps is that the fluid end component in the rod column includes an axial rod on which a piston head is mounted, e.g. the A.P.I. type SA connection. This attaching rod is often damaged as a result of which the entire fluid end component has to be scrapped.

Another object of the invention therefore, is to provide a fluid end component with a demountable attaching component such as a stud.

Another object of the invention is to provide a H.P. quick release fitting for couplings generally.

Another problem that occurs in known mud pumps is the accumulation of sand and other solids under the sealing element of the piston against the cylinder wall, causing damage to the element and excessive wear on the sealing element and the cylinder wall. The clearance between the piston and the cylinder wall increases due to this wear which increases the difficulty of the piston retaining its seal with head.

Another object of the invention is to provide a wash ring for us on mud pumps to locate the cooling and flushing fluid as close as possible to the heat generator (piston).

A further problem that affects slush pumps occurs at the power end where an intermediate extension rod (or pony rod) connects the crosshead with the power end component of the piston rod. The extension rod passes through a bulkhead where it is engaged by a seal; on one side of the bulkhead the rod is immersed in oil, and on the other side it is in an environment that contains mud and other corrosive and abrasive substances and as a result the outer surface of the rod is subject to wear which in turn damages the seal. More importantly however, the intermediate rod is subject to wear, the effects of corrosion, and fatigue at the end connecting it to the piston rod and when that connection wears out or fractures the entire rod is normally scrapped and replaced. Some attempts have been made to re-build these rods by welding on a new end connection. However, because of internal problems of welding and, general metal fatigue in the connection area, these attempts often end in failure that they attempt to avoid. The out surface of the rod is ground and highly polished and when wear occurs the surface has to be re-ground and re-polished which means that the rod is out of use during the time it has to be remachined.

A further disadvantage of some known intermediate extension rods is that the fluid end for connection to the piston rod has a larger diameter than the body thus preventing easy replacement of the bulkhead seal; at present, the extension rod must first be disconnected from the crosshead and removed so that the word seal can be removed and replaced.

A further object therefore is to provide an extension rod that can be re-used if the end connection to the piston rod fractures and that will allow easy replacement of a worn bulkhead seal.

According to one aspect of the present invention there is provided a H.P. reciprocating pump having a composite piston rod comprising a power end component, a fluid end component and a connector releasably connected to said end components, said connector having a pair of tensioned links extending therefrom and having coupling means to co-operate with coupling means on the end components, means within the connector for causing movement of the links against tension to move into cooperative disposition with the end components to permit coupling or uncoupling and for returning the .1inks under tension to secure the components when coupled against release.

Preferably, said coupling means comprises

Preferably also, the means within the connector for causing movement of the links comprises a pair of longitudinal pistons with the piston heads thereof in the back to back relation, wherein the links are the ends of the pistons opposite the piston heads, spring means tensioning the pistons inwardly of the connector and a space between the piston heads for pressurising fluid or mechanical means to move the piston apart against spring pressure.

Preferably also, a valve is provided in the body of connector to inject or release pressure fluid into or out of the space between the pistons.

According to a further aspect of the present invention there is provided a quick release fitting comprising, in combination a fitting body having an axial through passage the inner end of which is closed by a valve releasably seated against the fitting body and releasable to open the passage as a fluid channel, one or more radial fluid outlet passage means associated with the central passage for the injection of fluid into the internal openings of the radial passages in the fitting body, check means associated with the external outlets of the radial passages of the fitting body to permit movement of fluid in one direction only thereby to eliminate axial load on the fitting, and an inlet for nozzle for injecting pressurised fluid into the fitting body, said nozzle being adapted for location in the central passage of the fitting body and having a longitudinal fluid inlet passage which bends through an angle to exit from the side of the nozzle and align with the radial fluid inlet passage means of the filling body the nozzle also having a separate p.s.i. equalising bleed hole which extends through the nozzle from the end of the nozzle which locates in the fitting body to further prevent axial load on the fitting when it is pressurised.

According to a further aspect of the invention, there is provided a fluid end component for a composite piston rod of a H.P. reciprocating pump, wherein said component comprises a body and a rod or 'stud' extending longitudinally from an end thereof opposite to the end to be coupled to a connector joining the fluid end component to a power end component, said stud being removably secured to the component body.

Preferably, the stud has a threaded end for engagement in a threaded socket in the component body, and releasable restraining means to prevent rotation of the stud once fully inserted.

According to yet another aspect of the present invention, the fluid end component carried a piston head which has a body of resilient material and a co-axial support plate, said

According to another aspect of the invention, the fluid end component of the piston rod of a H.P. reciprocating pump includes a wash ring which abuts the piston head on the side remote from the skirt of the piston.

The wash ring may be attached to the piston or located on the piston rod.

According to a further aspect of the present invention, there is provided in a H.P. reciprocating pump an intermediate extension road to connect the cross-head at the power end of the pump to the power end of a piston rod of said pump, said intermediate extension rod comprising a cylindrical body a sleeve removeably located on the extension rod body via the fluid end of the extension rod, and a fluid end cap for removable location in a recess provided in the fluid end of the body said cap having one end for location within said recess and another end for connection to the power end of the piston rod. The end of the cap for connection to the piston rod may have the configuration of a specified makers fluid end connection for attachment to the power end of the piston rod assembly as defined in the tenth preceding paragraph. Alternatively, the end of the cap for connection to the piston rod is designed for direct connection to the power end of the tension link of the piston rod assembly as defined in the eleventh preceding paragraph.

An embodiment of the present invention will now be described by way of example, with reference to the accompanying drawings, in which:

Fig. 1 is a sectional side elevation of part of a piston rod component of a H.P. reciprocating pump according to the invention, showing the connector connected to the power end of the pump.

Figs. 2 and 3 and 4 illustrate typical types of power end connections.

Fig. 5 is a sectional side elevation of the other part of the piston rod, i.e. the fluid end with the piston mounted.

Fig. 6 is a sectional detail showing the H.P. quick release fitting which serves as the fluid inlet/outlet valve in the connector of the piston rod.

Fig 7 is a sectional detail showing the pressure source nozzle for location in the fluid valve.

Fig. 8 illustrates the piston wash ring; and Figs. 9 and 10 are sectional elevations of an intermediate extension rod according to the invention.

Referring firstly to Figs. 1 and 5, the piston rod of the H.P. reciprocating oilfield mud/slush pump is an assembly of a power end component 10, a fluid end component 11 and a tension-link connector 12 connecting the two

jects axially of the connector. Each link 15 is the outer rod portion of a pair of pistons 16 located within the body 13 in back-to-back relation such that a pressure-area space 17 is provided between the two piston heads 18. Spring means, such as coil springs 19 between the respective piston head 18, and end wall 14 resist outward movement of the piston. Thus, the pistons are normally in their withdrawn position as shown in Fig. 1 with the links 15 projecting a short distance out of the connector 12.

When the space 17 is pressurised the pistons 16 are forced outwards for a short distance just sufficient to bring a transverse opening 20 in each link into register with a similar opening in the two end components 10, 11 after which a clevis pin, for example, a spring pin, is inserted into each of the through openings.

When pressure in the space 17 is released, the pistons tend to be withdrawn inwards, thus tensioning the pin connections and retaining the end components 10, 11 securely attached to the tension-link connector 12. The operation of coupling the end components 10, 11 to the connector 12 takes no more than 30 seconds. To uncouple, the space 17 is again pressurised to release the tension or the locking pins which can then be easily removed out of the through openings. The couplings can be dismantled the piston changed, and reassembled in less than five minutes.

Referring now to Figs. 6 and 7, the pressure area space 17 communicates with a opening 21 (Fig. 1) in the wall of the connector body 13 *via* a valve 22 which is inserted into the opening 21. The valve 22 has a central through passage 23, the inner end of which is closed by a plug, e.g. a threaded socket head 24 which has a small bore central passage 25 therethrough and which terminates adjacent to a check valve such as a ball 26 spring urged at 27 against a seat 28 to close-off the passage 23. The valve 22 also has a series of radial through passages 29 communicating with the central passage 23 whereby pressurising fluid entering the valve 22 exits into space 17 via the radial passages 29. A check device, conveniently an O-ring 30 is stretched around the exterior of valve 22 to cover the outlets of the radial passages 29. The O-ring 30 gives as the pressurised fluid exits from the valve. The pressurising fluid is preferably grease but may be any other fluid or gas.

In order to relieve the pressure in space 17, an Hex Wrench or similar tool e.g. an Allan key is located in the central passage 23 of the valve 22 to screw the socket head plug 24 further into the valve and thereby unseat the check valve 26 and open an exit for the simply ooze out rather than spurt out.

The pressurising fluid is inserted into the valve by a nozzle 30 which has a fluid passage 31 having an axial run and a 90° bend to exit radially, and being designed so that the radial outlet 32 feeds into the radial passages 29 in the valve 22. The nozzle also has a p.s.i. equalizing bleed hole 33 which has an axial run from the inner end 34 of the nozzle and a 90° bend to exit through the side of the nozzle at 35 to atmosphere. Thus, if as the nozzle is passing pressurising fluid *via* passage 31/32 into space 17 via valve 22, the check valve 26 is not seated in the seat 28 and leakage of the fluid within the space 17 escapes by passing around the check valve 26, fluid can escape through a separate passage 33 in the nozzle thus alerting the operator that a leakage situation exists.

The nozzle is for example, attached to a H.P. source such as a grease gun.

Referring again to Fig. 5, the fluid end component 11 has an axial, outwardly extending rod or stud 40 on which is mounted a piston head 41 secured by a retaining nut 42.

The stud 40 is replaceably mounted in an axial recess 43 the body of the fluid end component, the stud and recess being attached together such as with a thread. When a thread is the preferred fastener, the inner end of the stud 40 has a recess 44 which when the stud if fully inserted registers with a through hole 45 in the component body, whereby a pin can be driven into the hole 45 to prevent further rotation of the stud 40.

The piston head 41 comprises a resilient body 46 mounted on a metal support plate 47 which carries the axial load on the piston head, the plate and body having co-axial central apertures by which they are slid into the stud 40. A cylindrical spacer 48 is then located on the stud after which the retaining nut 42 is screwed onto the outer end of the extending rod or stud.

The piston body includes a skirt 49 which has a slight flair so that it will 'give' within a cylinder and create a seal. The skirt terminates in a scraper lip 50 which scrapes abrasive materials, such as sand off the cylinder wall out of the path of the seal. Hitherto, such material could gather and pack under the skirt 49, i.e. between the skirt and the cylinder wall and cause damage to the fluid end components. The skirt of this embodiment however, has radial holes 51 adjacent to the scraper lip and these holes prevent the sand accumulating by allowing the sand to pass through the radial holes 51 towards the spacer 48. An additional benefit of these holes is to render the scraper lip 50 pressure neutral to reduce sidewall pressure as much as possible.

The piston body 46 is made of a resilient

seal 52 can be located in a seal groove on the outer periphery of the piston body 45.

A wash ring 53 is mounted on the fluid end component 11, hard against the piston head so as to bring the source of cooling water as close as possible to the source of heat generation, i.e. the piston head. The wash ring 53 is a hollow annular member shaped on one face to the contours of the piston body support plate 46 and in the present embodiment is located on the fluid end component 11 via a step 54 thereon prior to location of the piston head.

The wash ring has a circumferential slot 55 on its inner annular face; this is provided so that the ring 53 can be used on other rods and pistons by the addition of an annular plate 56 snap-fitted into the slot to carry the wash ring on a shaft or spindle 57 for example, on a standard SA—4 piston connection as illustrated in Fig. 8.

Referring again to Fig. 1, the power end component 10 terminates in a power end connection 60 by which the component 10 can be connected to various pump manufacturers power end connections by a unique piston rod power end mating configuration 61 (i.e. Figs. 2, 3 and 4). Several different power end components 10 are therefore produced to suit the various power end units of which three are illustrated in Figs. 2, 3 and 4, namely the shorter OILWELL (TM) or GARDNER-DENVER (TM) pump units (Figs. 2 and 3 and the longer National (TM) Mud Pump units (Fig. 4).

Referring now to Figs. 9 the power end components 60 couple to an intermediate extension rod 63 which at one end (the power end) is attached to the pump crankhead (not shown) and at the other end (the fluid end) has a configuration 64 which complements with the mating configuration 61 on the power end component 60. In Fig. 9, the configuration 64 is complementary to the National (TM) Mud Pump configuration 61 of Fig. 4. The extension rod 63 has a cylindrical body 65 whose diameter is reduced so that a sleeve 66 can be removeably slid on to it from the fluid end, and secured by a fluid end cap 67 is provided to locate in a recess 68 in the fluid end of the body 65. The sleeve 66 has a ground and highly polished outer surface which, when it becomes worn or damaged due to its immersion in corrosive and abrasive material, can be removed and replaced simply by removing the end cap 67.

The end cap 67 has a portion 69 which locates in the recess 68 and an external portion 70 which has the configuration of a specific manufacturers fluid end coupling. Thus, if the portion 70 fails through metal fatigue, the damaged cap 67 can be removed and replaced with a cap 67' which has a different fluid end configuration 64' which can be coupled to the power end link 15 of the tension link connector 12 of Fig. 1, thus eliminating the need for a special power end component 10. The elongated cap 67' becomes the power end component 10, and is connected directly to the crosshead (not shown). Elongated caps 67' of different lengths would be provided for the various pumps from different manufacturers.

The extension rod 63 may be a new article or a damaged rod which is converted, by machining to receive the sleeve 66 and end cap 67/67'. The end cap 67/67' is screwed into the recess 68 in the rod, the recess 68 and the inner portion 69 being threaded at 72, 73 for the purpose. In order to obtain a secure location of the cap in the recess fluid passages are 74, 75 and seals 76, 77 provided in the cap.

Referring firstly to Fig. 9, a central axial passage 74 runs through the cap 67 and a subsidiary much narrower passage 75 runs from the inner end of the passage 74 to an annular gap 78 formed by a waist 79 of the cap and the wall 80 of the recess 68. One seal 76 is inward of the screw thread 72 of the cap and the other 77 is outwardly of the waist 79 but both are within the recess 68.

A pressurised-fluid nozzle, such as the nozzle 30 hereinbefore described with reference to Fig. 6, is inserted into passage 74 and injects pressurised fluid *via* passage 75 into the gap 78. This is done after the cap 67 has been screwed tightly into recess 68 (using a wrench) so that the cap is torqued up to a torque specification. When this has been done, a shoulder 81 on the cap closely abuts the annular end face of the rod 65 and sleeve 66.

Injection of the pressurised fluid (such as grease) into the gap 78 between the seals 76, 77 causes the portion 69 to extend longitudinally by forcing the cap 67 outwards to open a gap between the shoulder 81 and the end face of the rod and sleeve. That gap is measured with a feeler gauge and at a specified width, the cap is again screwed in to the recess to close that gap.

As the passage 74 is open at its inner end and communicates with the bleed hole 33 in the nozzle 30, no pressure build up will occur in the inner end of the recess 68. Therefore the thread 73 in the recess 68 will not elongate due to the introduction of pressurised fluid; however, the thread 72 on the cap expands as the connector elongates due to a pressure differential because in inner seal 76 is of smaller diameter than the outer seal 77.

With the cap again screwed into the recess to close the gap between shoulder 81 and the

63.

On removal of the nozzle 30 from the cap 67, a plug 82 is removeably inserted into the passage 74 to ensure that passage 74/75 remains clear.

By fastening the cap 67 to the rod 63 in tension, there is less likelihood of the cap experiencing fatigue and of damage to the threads 72/73. When it is desired or necessary to remove the cap 67, the plug 82 is removed, the gap 78 is pressurised, the cap is unscrewed until a gap of specified width has opened up between shoulder 81 and the end face of the rod and sleeve, pressure is released to close that gap and the cap is then unscrewed from the rod.

In Fig. 10, the passage 74' is not totally axial due to the length of the external part of the cap. Thus passage 74' angles to open out at the side of the cap for the introduction of the pressurised-fluid nozzle 30. Otherwise, the procedure for fitting and releasing the cap to and from the rod is as hereinbefore described with reference to Fig. 9.

Modifications may be made without departing from the scope of the invention. For example, with reference to Fig. 1, the piston heads 18 may be moved by mechanical means such as a cam, housed in the space 17 and actuated by a key inserted through an aperture in the side of the connector body. Also, the spring means may be other than springs 19. Referring to Fig. 5, the threaded replaceable stud 40 may be secured against further rotation by an adhesive which can be broken down by heat at a temperature well above its normal working temperature.

With reference to Fig. 7, the nozzle of the quick release fitting may be modified to check the ejection of the pressurised medium whenever the nozzle is removed from the ma ing part of the fitting e.g. ball valve in the fluid outlet passage of the nozzle unsealed at insertion of the nozzle into the mating of the fitting.

Referring to Figs. 9 and 10, the end cap 67/67' may be elongated by an internal pressure than than by an external pressure, i.e. the interior of the cap is pressurised to cause elongation.

The H.P. reciprocating slush pump as hereinbefore described has many advantages. For example, the provision of various power end components 10/61 allows the piston rod 10-12, as hereinbefore described to be used in a number of different pumps; the tension-link connector 12, allows for relatively quick make-up of dismantling of the piston rod; the apertured skirt 49 on the piston head 41 prevents damage by accumulating sand and the removable wash ring 53 is positioned to bring the source of cooling water as close as possible connection piece fails through metal fatigue, and the fluid end connection can be designed as a reproduction of a manufacturers specific original connection or as a replacement which connects directly to connecting link of the piston rod assembly connector; also the sleeve on the rod can be quickly replaced if damaged by wear as can the bulkhead seal through which the extension rod slidingly extends.

Finally, the quick release fitting provides a H.P. fitting that can be quickly assembled and disassembled without external fasteners. It is inherently safe, cannot blow apart when pressurised, and if accidentally yanked free it does not allow pressurised fluid to exit from the vessel being pressurised.

CLAIMS

1. A piston rod assembly for an H.P. reciprocating pump comprising a power end component, a fluid end component, and a connector releasably connected to said end components, said connector having a pair of tensioned links extending therefrom and having coupling means to co-operate with coupling means on the end components, means within the connector for causing movement of the links against tension to move into co-operative disposition with the end components to permit coupling or uncoupling and for returning the links under tension to secure the components when coupled against release.

2. An assembly as claimed in claim 1, in which said coupling means comprises apertures in the components and respective links which register in the co-operative disposition for location therein of a coupling pin.

3. An assembly as claimed in claim 1 or 2 in which the means within the connector for causing movement of the links comprises a pair of longitudinal pistons with the piston heads thereof in the back to back relation, wherein the Links are the ends of the pistonsopposite the piston heads, spring means tensioning the pistons inwardly of the connector and a space between the piston heads for pressurising fluid or mechanical means to move the piston apart against spring pressure.

4. An assembly as claimed in claim 3 in which a valve is provided in the connector to inject or release pressure fluid into or out of the space between the pistons.

5. An assembly as claimed in claim 4, in which the valve comprises, in combination, a fitting body having an axial through passage the inner end of which is closed by a valve releasably seated against the fitting body and releasable to open the passage as a fluid channel, one or more radial fluid outlet passage means associated with the central passage for the injection of fluid into the internal openings of the radial passages in the fitting

rection only thereby to eliminate axial load on the fitting, and an inlet nozzle for injecting pressurised fluid into the fitting body, said nozzle being adapted for location in the central passage of the fitting body and having a longitudinal fluid inlet passage which bends through an angle to exit from the side of the nozzle and align with the radial fluid inlet passage means of the filling body the nozzle also having a separate p.s.i. equalising bleed hole which extends through the nozzle from the end of the nozzle which locates in the fitting body to further prevent axial load on the fitting when it is pressurised.

6. A quick release fitting comprising in combination a fitting body having an axial through passage the inner end of which is closed by a valve releasably seated against the fitting body and releasable to open the passage as a fluid channel, one or more radial fluid outlet passage means associated with the central passage for the injection of fluid into the internal openings of the radial passages in the fitting body, check means associated with the external outlets of the radial passages of the fitting body to permit movement of the fluid in one direction only thereby to eliminate axial load on the fitting, and an inlet nozzle for injecting pressurised fluid into the fitting body, said nozzle being adapted for location in the central passage of the fitting body and having a longitudinal fluid inlet passage which bends through an angle to exit from the side of the nozzle and align with the radial fluid inlet passage means of the filling body the nozzle also having a separate p.s.i. equalising bleed hole which extends through the nozzle from the end of the nozzle which locates in the fitting body to further prevent axial load on the fitting when it is pressurised.

7. A fluid end component for a composite piston rod of an H.P. reciprocating pump, comprising a body and a rod or 'stud' extending longitudinally from an end thereof opposite to the end to be coupled to a connector joining the fluid end component to a power end component, said stud being removably secured to the component body.

8. A fluid end component as claimed in claim 7, in which the stud has a threaded end for engagement in a threaded socket in the component body, and releasable restraining means to prevent rotation of the stud once fully inserted.

9. A fluid end component for a composite piston rod of an H.P. reciprocating pump, in which the component carries a piston head which has a body of resilient material and a co-axial support plate, said body having a skirt remote from the support plate and terminating in a scraper lip which is oresssure balanced by abuts the piston head on the side remote from the skirt of the piston.

11. An H.P. reciprocating pump in which there is provided an intermediate extension rod to connect the crosshead at the power end of the pump to the power end of a piston rod of said pump, said intermediate extension rod comprising a cylindrical body, a sleeve removeably located on the extension rod body via the fluid end of the extension rod, and a fluid end cap for removeable location in a recess provided in the fluid end of the body said cap having one end for location within said recess and another end for connection to the power end of the piston rod.

12. A pump as claimed in claim 11, in which the end of the cap for connection to the piston rod may have the configuration of a specified makers fluid end connection for attachment to the power end of the piston rod assembly as claimed in claim 1.

13. A pump as claimed in claim 11 in which the end of the cap for connection to the piston rod is designed for direct connection to the power end of the tension link of the piston rod assembly as claimed in claim 1.

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